INSTALLATION AND OPERATION MANUAL

FOM-E3/ETH, FOM-T3/ETH

10/100BaseT over E3/T3 Fiber Optic Modems

Version 1.0

RAD
data communications
The Access Company

FOM-E3/ETH, FOM-T3/ETH

10/100BaseT over E3/T3 Fiber Optic Modems

Version 1.0

Installation and Operation Manual

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Product Disposal

To facilitate the reuse, recycling and other forms of recovery of waste equipment in protecting the environment, the owner of this RAD product is required to refrain from disposing of this product as unsorted municipal waste at the end of its life cycle. Upon termination of the unit's use, customers should provide for its collection for reuse, recycling or other form of environmentally conscientious disposal.

General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

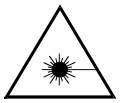
Safety Symbols

Warning

This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.

Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.

Protective ground: the marked lug or terminal should be connected to the building protective ground bus.



Warning

Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached.

Please observe the following precautions:

- Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.
- Do not attempt to adjust the laser drive current.
- Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.
- The use of optical devices with the equipment will increase eye hazard.
- Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.

ATTENTION: The laser beam may be invisible!

In some cases, the users may insert their own SFP laser transceivers into the product. Users are alerted that RAD cannot be held responsible for any damage that may result if non-compliant transceivers are used. In particular, users are warned to use only agency approved products that comply with the local laser safety regulations for Class 1 laser products.

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective ground terminal. If a ground lug is provided on the product, it should be connected to the protective ground at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in grounded racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Some products may have panels secured by thumbscrews with a slotted head. These panels may cover hazardous circuits or parts, such as power supplies. These thumbscrews should therefore always be tightened securely with a screwdriver after both initial installation and subsequent access to the panels.

Connecting AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A (20A for USA and Canada). The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A (40A for USA and Canada).

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

In cases when the power distribution system is IT type, the switch must disconnect both poles simultaneously.

Connecting DC Power

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC power systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

Make sure that the DC power supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A (20A for USA and Canada). The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A (40A for USA and Canada).

Before connecting the DC supply wires, ensure that power is removed from the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

If the DC power supply is floating, the switch must disconnect both poles simultaneously.

Connecting Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The grounding and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good ground connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the ground bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Warning per EN 55022 (CISPR-22)

Warning	This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.
Avertissement	Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.
Achtung	Das vorliegende Gerät fällt unter die Funkstörgrenzwertklasse A. In Wohngebieten können beim Betrieb dieses Gerätes Rundfunkströrungen auftreten, für deren Behebung der Benutzer verantwortlich ist.

Mise au rebut du produit

Afin de faciliter la réutilisation, le recyclage ainsi que d'autres formes de récupération d'équipement mis au rebut dans le cadre de la protection de l'environnement, il est demandé au propriétaire de ce produit RAD de ne pas mettre ce dernier au rebut en tant que déchet municipal non trié, une fois que le produit est arrivé en fin de cycle de vie. Le client devrait proposer des solutions de réutilisation, de recyclage ou toute autre forme de mise au rebut de cette unité dans un esprit de protection de l'environnement, lorsqu'il aura fini de l'utiliser.

Instructions générales de sécurité

Les instructions suivantes servent de guide général d'installation et d'opération sécurisées des produits de télécommunications. Des instructions supplémentaires sont éventuellement indiquées dans le manuel.

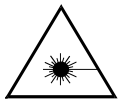
Symboles de sécurité

Avertissement

Ce symbole peut apparaitre sur l'équipement ou dans le texte. Il indique des risques potentiels de sécurité pour l'opérateur ou le personnel de service, quant à l'opération du produit ou à sa maintenance.

Danger de choc électrique ! Evitez tout contact avec la surface marquée tant que le produit est sous tension ou connecté à des lignes externes de télécommunications.

Mise à la terre de protection : la cosse ou la borne marquée devrait être connectée à la prise de terre de protection du bâtiment.



Avertissement

Certains produits peuvent être équipés d'une diode laser. Dans de tels cas, une étiquette indiquant la classe laser ainsi que d'autres avertissements, le cas échéant, sera jointe près du transmetteur optique. Le symbole d'avertissement laser peut aussi être joint.

Veuillez observer les précautions suivantes :

- Avant la mise en marche de l'équipement, assurez-vous que le câble de fibre optique est intact et qu'il est connecté au transmetteur.
- Ne tentez pas d'ajuster le courant de la commande laser.
- N'utilisez pas des câbles ou connecteurs de fibre optique cassés ou sans terminaison et n'observez pas directement un rayon laser.
- L'usage de périphériques optiques avec l'équipement augmentera le risque pour les yeux.
- L'usage de contrôles, ajustages ou procédures autres que celles spécifiées ici pourrait résulter en une dangereuse exposition aux radiations.

ATTENTION : Le rayon laser peut être invisible !

Les utilisateurs pourront, dans certains cas, insérer leurs propres émetteurs-récepteurs Laser SFP dans le produit. Les utilisateurs sont avertis que RAD ne pourra pas être tenue responsable de tout dommage pouvant résulter de l'utilisation d'émetteurs-récepteurs non conformes. Plus particulièrement, les utilisateurs sont avertis de n'utiliser que des produits approuvés par l'agence et conformes à la réglementation locale de sécurité laser pour les produits laser de classe 1.

Respectez toujours les précautions standards de sécurité durant l'installation, l'opération et la maintenance de ce produit. Seul le personnel de service qualifié et autorisé devrait effectuer l'ajustage, la maintenance ou les réparations de ce produit. Aucune opération d'installation, d'ajustage, de maintenance ou de réparation ne devrait être effectuée par l'opérateur ou l'utilisateur.

Manipuler des produits sous tension

Règles générales de sécurité

Ne pas toucher ou altérer l'alimentation en courant lorsque le câble d'alimentation est branché. Des tensions de lignes peuvent être présentes dans certains produits, même lorsque le commutateur (s'il est installé) est en position OFF ou si le fusible est rompu. Pour les produits alimentés par CC, les niveaux de tension ne sont généralement pas dangereux mais des risques de courant peuvent toujours exister.

Avant de travailler sur un équipement connecté aux lignes de tension ou de télécommunications, retirez vos bijoux ou tout autre objet métallique pouvant venir en contact avec les pièces sous tension.

Sauf s'il en est autrement indiqué, tous les produits sont destinés à être mis à la terre durant l'usage normal. La mise à la terre est fournie par la connexion de la fiche principale à une prise murale équipée d'une borne protectrice de mise à la terre. Si une cosse de mise à la terre est fournie avec le produit, elle devrait être connectée à tout moment à une mise à la terre de protection par un conducteur de diamètre 18 AWG ou plus. L'équipement monté en châssis ne devrait être monté que sur des châssis et dans des armoires mises à la terre.

Branchez toujours la mise à la terre en premier et débranchez-la en dernier. Ne branchez pas des câbles de télécommunications à un équipement qui n'est pas mis à la terre. Assurez-vous que tous les autres câbles sont débranchés avant de déconnecter la mise à la terre.

Connexion au courant du secteur

Assurez-vous que l'installation électrique est conforme à la réglementation locale.

Branchez toujours la fiche de secteur à une prise murale équipée d'une borne protectrice de mise à la terre.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A (20A aux Etats-Unis et Canada). Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A (40A aux Etats-Unis et Canada).

Branchez toujours le câble d'alimentation en premier à l'équipement puis à la prise murale. Si un commutateur est fourni avec l'équipement, fixez-le en position OFF. Si le câble d'alimentation ne peut pas être facilement débranché en cas d'urgence, assurez-vous qu'un coupe-circuit ou un disjoncteur d'urgence facilement accessible est installé dans l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si le système de distribution de courant est de type IT.

Connexion d'alimentation CC

Sauf s'il en est autrement spécifié dans le manuel, l'entrée CC de l'équipement est flottante par rapport à la mise à la terre. Tout pôle doit être mis à la terre en externe.

A cause de la capacité de courant des systèmes à alimentation CC, des précautions devraient être prises lors de la connexion de l'alimentation CC pour éviter des courts-circuits et des risques d'incendie.

Assurez-vous que l'alimentation CC est isolée de toute source de courant CA (secteur) et que l'installation est conforme à la réglementation locale.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A (20A aux Etats-Unis et Canada). Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A (40A aux Etats-Unis et Canada).

Avant la connexion des câbles d'alimentation en courant CC, assurez-vous que le circuit CC n'est pas sous tension. Localisez le coupe-circuit dans le tableau desservant l'équipement et fixez-le en position OFF. Lors de la connexion de câbles d'alimentation CC, connectez d'abord le conducteur de mise à la terre à la borne correspondante, puis le pôle positif et en dernier, le pôle négatif. Remettez le coupe-circuit en position ON.

Un disjoncteur facilement accessible, adapté et approuvé devrait être intégré à l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si l'alimentation en courant CC est flottante.

Declaration of Conformity

Manufacturer's Name:	RAD Data Communications Ltd.
Manufacturer's Address:	24 Raoul Wallenberg St., Tel Aviv 69719, Israel

declares that the product:

Product Name:	FOM-E3/ETH, FOM-T3/ETH

conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022:1998 + A1:2000, A2:2003	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
	EN 55024:1998 + A1:2001, A2:2003	Information technology equipment – Immunity characteristics – Limits and methods of measurement.
Safety:	EN 60950-1:2001	Information technology equipment – Safety – Part 1: General requirements.

Supplementary Information:

The product herewith complies with the requirements of the EMC Directive 89/336/EEC, the Low Voltage Directive 2006/95/EC and the R&TTE Directive 99/5/EC for wired equipment. The product was tested in a typical configuration.

Tel Aviv, 21 June 2007

Haim Karshen

VP Quality

European Contact: RAD Data Communications GmbH, Otto-Hahn-Str. 28-30, 85521 Ottobrunn-Riemerling, Germany

Quick Start Guide

If you are familiar with FOM-E3/ETH and FOM-T3/ETH modems, use this guide to prepare the units for operation.

1. Installing FOM-E3/ETH and FOM-T3/ETH

Open the FOM-E3/ETH or FOM-T3/ETH case by releasing the two rear panel screws and sliding out the PCB interior of the unit.

Setting the Internal Jumpers

Setting the Main Board Jumper

Set the main board jumper according to the following table:

Jumper	Description	Values	Factory Setting
AIS, JP5	Controls the AIS transmission	**ON** – AIS is transmitted **OFF** – AIS is not transmitted	ON

Configuring the Ethernet Interface

Configure the Ethernet interface according to the table below:

Section	Name	Description	Possible Settings	Factory Setting
1	NC			OFF
2	FLC	Enables or disables flow control	**ON** – Flow control is enabled **OFF** – Flow control is disabled	 OFF
3	10/100	Selects the LAN speed	**ON** – LAN speed is set to 100 Mbps **OFF** – LAN speed is set to 10 Mbps	OFF
4	AN1	Controls the LAN autonegotiation	**ON** – LAN autonegotiation is disabled **OFF** – LAN autonegotiation is enabled	 OFF
5	HF1	Selects the LAN mode	**ON** – LAN full duplex mode **OFF** – LAN half duplex mode	 OFF
6	BPR	Controls the backpressure	**ON** – Backpressure is enabled **OFF** – Backpressure is disabled	 OFF

Section	Name	Description	Possible Settings	Factory Setting
7	MUL	Controls LAN to WAN multicasting	**ON** – Multicast messages from LAN to WAN are blocked	
			OFF – Multicast messages from LAN to WAN are not blocked	OFF
8	SCR	Controls the scrambling of Ethernet frames	**ON** – Ethernet frames are scrambled	
			OFF – Ethernet frames are left unchanged	OFF

Note

After configuring the Ethernet interface, reset FOM-E3/ETH or FOM-T3/ETH by turning it off and on. The changes take effect only after the reset.

Connecting the Cables

➤ To connect cables:

1. Connect the E3 or T3 fiber optic interface.
2. Connect the Ethernet interface to the LAN.
3. Connect the power cable (first to the modem, then to the mains supply).

2. Operating FOM-E3/ETH and FOM-T3/ETH

Verify LED status:

- The PWR LED should be ON.
- The LINK and ACT LEDs should be ON, when the link to the LAN is established, and data is transferred over the Ethernet link.
- The ETH 100 LED is ON when the modems work in the 100 Mbps mode.

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Chapter 1
Introduction

1.1 Overview

FOM-E3/ETH and FOM-T3/ETH are fiber optic modems for transmission of 10BaseT or 100BaseT signals over E3/T3 services via multimode or single mode fiber optic media.

Product Options

Model Options

- FOM-E3/ETH: 10/100BaseT over E3 fiber optic services
- FOM-T3/ETH: 10/100BaseT over T3 fiber optic services.

Power Options

- AC power supply: 100 to 240 VAC
- DC power supply: 20 to 72 VDC.

Application

Figure 1-1 shows FOM-E3/ETH and FOM-T3/ETH extending 10/BaseT traffic over a fiber optic link. The FOM-E3 or FOM-T3 modem provides E3/T3 electrical access to SDH/SONET. The RIC-E3/ETH or RIC-T3/ETH device converts the E3/T3 signal back to the 10/100BaseT traffic at the central office or POP.

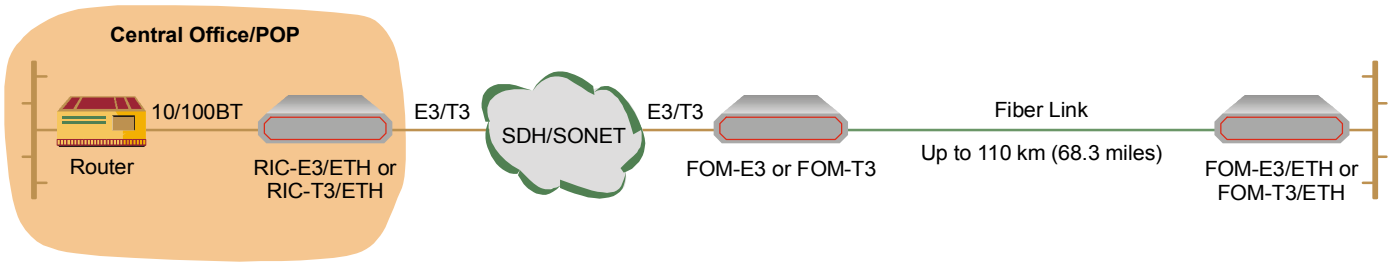


Figure 1-1. 10/100BaseT Service Extension over E3/T3 Fiber Link

Features

Ethernet Interface

The Ethernet interface of the FOM-E3/ETH and FOM-T3/ETH modems is a high performance self-learning Ethernet bridge module, fully compatible with IEEE 802.3/Ethernet V.2, IEEE 802.1p standards. It also supports the relevant parts of the IEEE 802.1q standard, enabling VLAN applications.

The Ethernet interface provides one LAN connection, which can be either 10BaseT (UTP) or 100BaseT (UTP), both with VLAN tagging support.

Two-level packet prioritization is implemented for VLAN in conformance with the IEEE 802.1p standard.

The LAN link operates at a data rate of up to 10 Mbps for 10BaseT ports or up to 100 Mbps for 100BaseT ports.

Autonegotiation allows plug-and-play Ethernet connection.

The Ethernet module is configured via an internal DIP switch.

E3/T3 Fiber Optic Interface

FOM-E3/ETH and FOM-T3/ETH are designed to operate with several different grades and sizes of fiber optic cable and provide the user with:

- Extended high rate range transmission
- Immunity to electrical interference such as EMI, RFI, spikes and differential ground loops
- Secure data transfer (no tapping on the transmitted information)
- Protection from sparks and lightning
- Secure link in hazardous or hostile environment.

Table 1-1. FOM-E3/ETH and FOM-T3/ETH Fiber Optic Interface Options

Wavelength [nm]	Fiber Type [μm]	Transmitter Type	Typical Power [dBm]	Receiver Sensitivity [dBm]	Typical Max. Range [km]	[mi]
850	62.5/125 multimode	VCSEL	-15	-34	4.5	2.8
1310	9/125 single mode	Laser	-12	-31	38	23.6
1310	9/125 single mode	Laser (long haul)	-2	-34	70	43.4
1550	9/125 single mode	Laser	-12	-31	68	42.2
1550	9/125 single mode	Laser (long haul)	-1	-34	110	68.3
1310/1550	9/125 single mode	Laser (WDM), SF1, SF2	-12	-30	40	24.8
1310	9/125 single mode	Laser (single strand fiber), SF3	-12	-27	20	12.4

Alarms

When FOM-E3/ETH or FOM-T3/ETH detects that the bit error rate of the signal received from the optical interface is 10^{-6} or worse, the modem transmits an "All 1s" signal (AIS) to the optical interface.

When an AIS is detected at the optical interface, the modem transparently converts the signal and alerts the user via front panel LEDs and the alarm relay port.

Likewise, an alarm is relayed if a high bit error rate is detected at the fiber optic interface.

1.2 Physical Description

Figure 1-2 illustrates a 3D view of the FOM-E3/ETH and FOM-T3/ETH units.

Figure 1-2. FOM-E3/ETH and FOM-T3/ETH, 3D View

The FOM-E3/ETH and FOM-T3/ETH front panels contain LEDs for indication of the E3/T3 and Ethernet interface status. For details, refer to *Chapter 3*.

The rear panel of the unit allows access to the interface, alarm relay and power connections. The rear panel is described in greater detail in *Chapter 2*.

1.3 Functional Description

Figure 1-2 illustrates the FOM-E3/ETH and FOM-T3/ETH functional diagram.

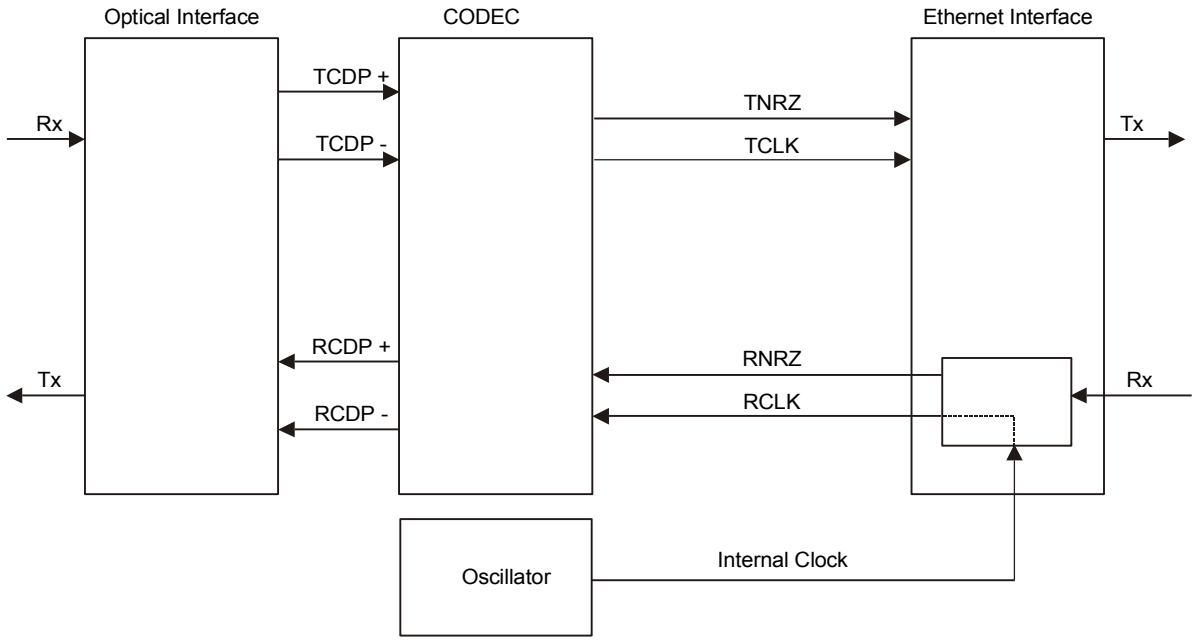


Figure 1-3. FOM-E3/ETH and FOM-T3/ETH Functional Diagram

E3/T3 Fiber Optic Interface

The fiber optic interface uses an infrared light emitting diode or laser transmitter to send a CDP-coded signal received from the CODEC over the fiber cable. At the opposite end of the fiber, the fiber optic interface receives the optical transmission and sends it to the CODEC for decoding.

CODEC

Coder/decoder (CODEC) converts an NRZ signal received from the electrical interface into the CDP signal and sends it to the fiber optic interface for transmission. At the opposite end of the fiber, the CODEC converts the CDP optic signal into NRZ electrical signal.

Ethernet Interface

The Ethernet interface includes a high performance self-learning Ethernet bridge, which is connected to the LAN via a single 10BaseT or 100BaseT port, operating in full duplex. The Ethernet interface supports VLANs.

The module automatically learns the MAC addresses of the LAN to which it is connected. Its LAN table stores up to 1,000 addresses with 5-minute automatic aging.

Filtering and forwarding is performed at the maximum theoretical rate of 150,000 packets per second (wire speed). The buffer with 512 kbit SRAM can hold 85 frames with a throughput latency of one frame. The forwarding of the multicast messages from LAN to WAN can be disabled.

Timing

Figure 1-3 shows flow of the clock signals in the FOM-E3/ETH or FOM-T3/ETH unit. The modems support only internal clock, where an on-board crystal oscillator (±25 ppm) serves as the timing source for the system.

Alarm Relay

FOM-E3/ETH and FOM-T3/ETH feature an alarm port, used for the relay of the alarm conditions (AIS and ERR) by means of Normally Open and Normally Closed dry contacts, using different pins of the DB-9 port connector.

1.4 Technical Specifications

Fiber Optic Interface	*Operating Wavelength*	850 nm, 1310 nm, or 1550 nm (see *Table 1-1*)
	Line Coding	CDP
	Connectors	ST, FC, or SC
	Output Power	See *Table 1-1*
	Receiver Sensitivity	See *Table 1-1*
	Range	See *Table 1-1*
Ethernet Interface	*LAN Table*	1,000 MAC addresses
	Aging	5 minute, automatic
	Filtering and Forwarding Rate	150,000 packets per second, max
	Buffer Size	85 frames
	Delay	1 frame
	LAN Standard	IEEE 802.3/Ethernet V.2, IEEE 802.1p
	LAN Data Rate	• 10BaseT: 10 Mbps (20 Mbps in full duplex) • 100BaseT: 100 Mbps (200 Mbps in full duplex)
	Transmission Line	4-wire, Category 5 UTP, 19 AWG to 26 AWG
	Line Code	• 10BaseT: Manchester • 100BaseT: MLT3
	WAN Protocol	Point-to-point

	Overhead	30 bits per frame (added to the Ethernet frames when they are sent toward E3/T3 line)
	Connector	RJ-45
Timing	*Clock Source*	Internal clock provided by on-board crystal oscillator (±25 ppm)
Indicators	*PWR*	ON – FOM-E3/ETH or FOM-T3/ETH is powered up
	OPTICAL ERR	ON – Bit error rate of the signal received from the optical interface is 10^{-6} or worse
	OPTICAL AIS	ON – E3/T3 interface received Alarm Indication Signal
	ETH LINK	ON – LAN is connected to the Ethernet interface
	ETH ACT	ON – LAN is receiving/transmitting data
	ETH 100	ON – LAN is operating at 100 Mbps OFF – LAN is operating at 10 Mbps
Alarm Relay	*Connector*	9-pin, D-type female (dry)
	Operation	Normally Open and Normally Closed, using different pins
Power	*AC Source*	100 to 240 VAC, 50 or 60 Hz, 15 VA
	DC Source	24 or 48VDC nominal (20 to 72 VDC), 9W
Physical	*Height*	4.4 cm (1.7 in)
	Width	19.4 cm (7.6 in)
	Depth	24.3 cm (9.6 in)
	Weight	1.4 kg (3.0 lb)
Environment	*Temperature*	0° to 50°C (32° to 122°F)
	Humidity	Up to 90%, non-condensing

Chapter 2

Installation and Setup

This chapter describes installation procedures for the standalone FOM-E3/ETH and FOM-T3/ETH devices.

After installing the unit, refer to *Chapter 3* for the system operation information.

Refer to *Chapter 4* for troubleshooting and diagnostics information.

Warning

Internal settings, adjustment, maintenance, and repairs may be performed only by a skilled technician who is aware of the hazards involved.

Always observe standard safety precautions during installation, operation and maintenance of this product.

Note

Before installing the product, review Handling Energized Products *at the beginning of the manual.*

2.1 Site Requirements and Prerequisites

AC-powered FOM-E3/ETH and FOM-T3/ETH units should be installed within 1.5m (5 ft) of an easily-accessible grounded AC outlet capable of furnishing the required supply voltage, in the range of 100 to 240 VAC.

DC powered FOM-E3/TH and FOM-T3/ETH units require a 24 or 48 VDC (20 to 72 VDC) source.

Allow at least 90 cm (36 in) of frontal clearance for operator access and at least 10 cm (4 in) clearance at the rear of the unit for interface cable connections.

The ambient operating temperature of FOM-E3/ETH and FOM-T3/ETH should be 0° to 50°C (32° to 122°F), at a relative humidity of up to 90%, non-condensing.

2.2 Package Contents

The FOM-E3/ETH or FOM-T3/ETH package includes the following items:

- FOM-E3/ETH or FOM-T3/ETH unit
- Last Mile Access and Intelligent Modems CD
- AC power cord or DC power supply connector kit
- RM-9 kit for mounting one or two units in a 19-inch rack (if ordered).

2.3 Installation and Setup

FOM-E3/ETH and FOM-T3/ETH are standalone devices intended for tabletop or 19-inch rack installation. They are delivered completely assembled. No provision is made for bolting the unit on the tabletop.

➤ **To install FOM-E3/ETH or FOM-T3/ETH:**

1. Determine the required configuration of FOM-E3/ETH or FOM-T3/ETH according to your application, and set the internal jumpers and switches accordingly.
2. Connect the fiber optic lines and the LAN.
3. Connect power to the unit.

Setting the Internal Jumpers

This section provides information on the functions of the FOM-E3/ETH and FOM-T3/ETH jumpers, and gives step-by-step instructions for performing the internal settings. The default settings are also listed.

Locations of Jumpers and Switches

FOM-E3/ETH and FOM-T3/ETH include three printed circuit boards (PCBs): the main board, fiber optic interface board, and Ethernet interface board (see *Figure 2-1* and *Figure 2-2*).

The **main board** contains the common signal processing circuits. One jumper, JP5, is provided for user settings.

The **fiber optic interface board** provide connection to the fiber optic links. This board does not contain any jumpers for user selection.

The **Ethernet interface board** provides LAN connection. The Ethernet board contains an 8-section DIP switch for the interface configuration.

Opening the Case

To reach the internal jumpers and switch of FOM-E3/ETH and FOM-T3/ETH, it is necessary to open its case.

Warning

Access to the inside of FOM-E3/ETH and FOM-T3/ETH is permitted only to authorized and qualified service personnel.

To avoid accidental electric shock, always disconnect the interface cables and the power cord before removing the units from their casing.

Line voltages are present inside FOM-E3/ETH and FOM-T3/ETH when they are connected to power and/or to the lines. Moreover, under external fault conditions dangerous voltages may appear on the lines connected to the units.

Any adjustment, maintenance, and repair of the opened equipment under voltage should be avoided as much as possible and, when absolutely necessary, should be carried out only by a skilled technician who is aware of the hazard involved. Capacitors inside the instruments may still be charged even after the instruments have been disconnected from their power source.

Caution FOM-E3/ETH and FOM-T3/ETH contain components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components. Before moving jumpers, touch the FOM-E3/ETH or FOM-T3/ETH frame.

➤ **To open the FOM-E3/ETH or FOM-T3/ETH case:**

1. Disconnect all the cables connected to FOM-E3/ETH or FOM-T3/ETH.
2. Release the two rear panel screws and use them as levers to slide out the PCB interior of the unit.

Setting the Main Board Internal Jumpers

The internal jumpers located on the FOM-E3/ETH or FOM-T3/ETH main board are identified in *Figure 2-1*. The jumper settings are described in *Table 2-1*.

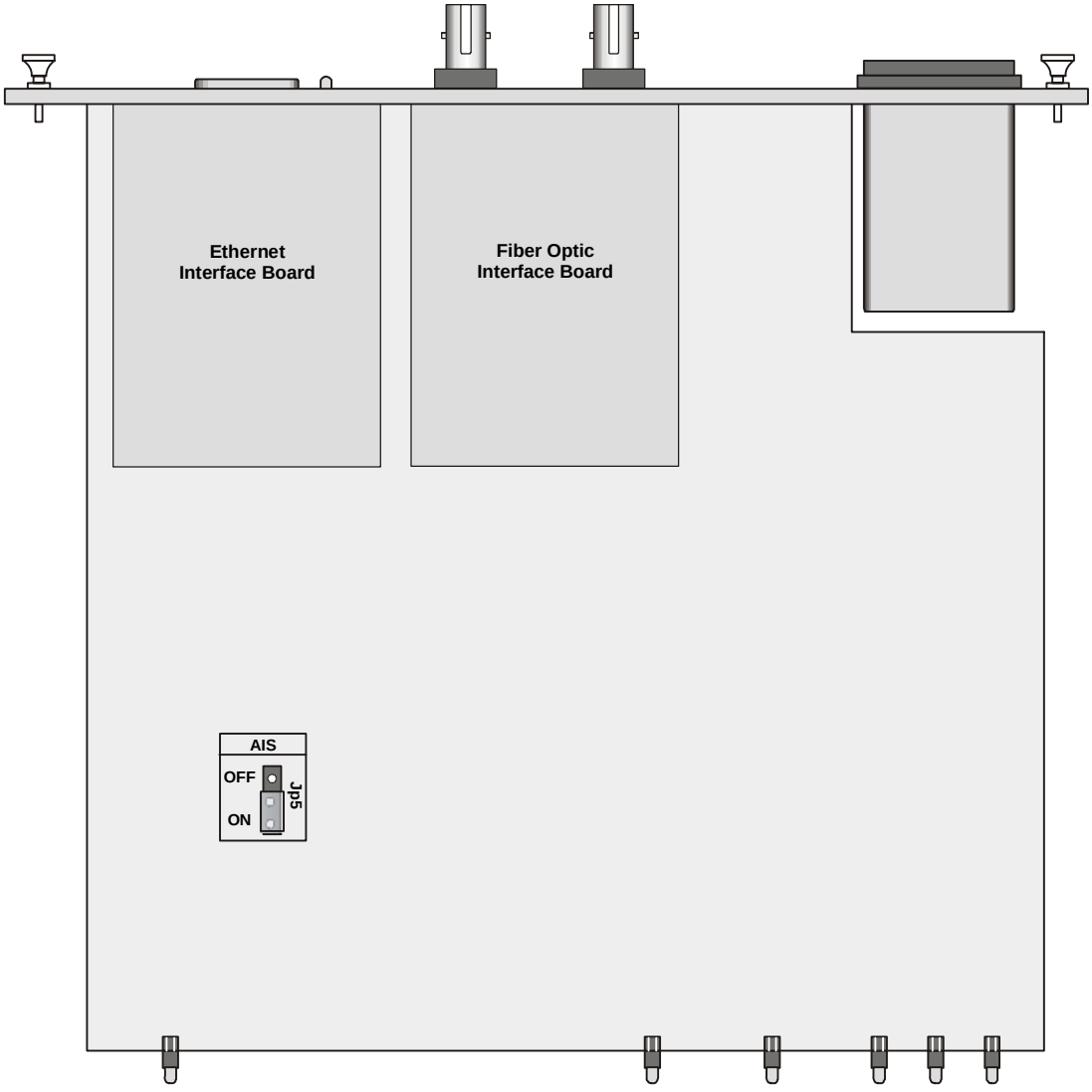


Figure 2-1. Main Board Layout

Table 2-1. Main Board Jumper Settings

Jumper	Description	Values	Factory Setting
AIS, JP5	Controls the AIS transmission	**ON** – AIS is transmitted **OFF** – AIS is not transmitted	ON

Note

The FOM-E3/ETH and FOM-T3/ETH main boards contain an additional jumper, JP1, which is factory-set to INT and must not be moved by the user.

Configuring the Ethernet Interface

The Ethernet interface board of FOM-E3/ETH and FOM-T3/ETH contains a DIP switch, which is used for the bridge and LAN interface configuration (see *Figure 2-2*).

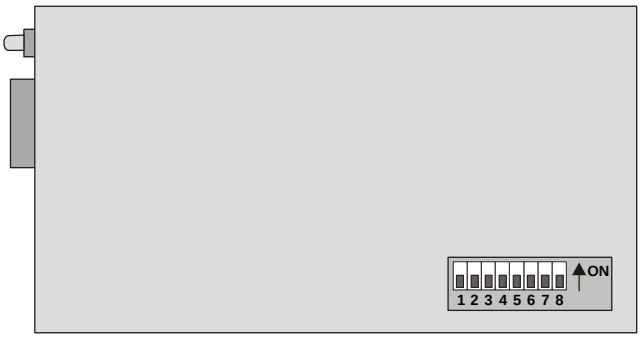


Figure 2-2. Ethernet Interface Board Layout

➤ **To configure the Ethernet interface:**

1. Set the DIP switch located on the Ethernet interface board according to your application requirements (see *Table 2-2*).
2. Reset FOM-E3/ETH or FOM-T3/ETH by turning it off and back on.

Table 2-2. Ethernet Interface DIP Switch Settings

Section	Name	Description	Possible Settings	Factory Setting
1	NC			OFF
2	FLC	Enables or disables flow control	**ON** – Flow control is enabled **OFF** – Flow control is disabled	 OFF
3	10/100	Selects the LAN speed	**ON** – LAN speed is set to 100 Mbps **OFF** – LAN speed is set to 10 Mbps	OFF
4	AN1	Controls the LAN autonegotiation	**ON** – LAN autonegotiation is disabled **OFF** – LAN autonegotiation is enabled	 OFF
5	HF1	Selects the LAN mode	**ON** – LAN full duplex mode **OFF** – LAN half duplex mode	 OFF
6	BPR	Controls the backpressure	**ON** – Backpressure is enabled **OFF** – Backpressure is disabled	 OFF

Section	Name	Description	Possible Settings	Factory Setting
7	MUL	Controls LAN to WAN multicasting	**ON** – Multicast messages from LAN to WAN are blocked	
			OFF – Multicast messages from LAN to WAN are not blocked	OFF
8	SCR	Controls the scrambling of Ethernet frames	**ON** – Ethernet frames are scrambled	
			OFF – Ethernet frames are left unchanged	OFF

Closing the Case

Once you finish the internal settings, you have to close the FOM-E3/ETH and FOM-T3/ETH case.

➤ **To close the FOM-E3/ETH or FOM-T3/ETH case:**

1. Slide the PCB assembly back into the case.
2. Screw in the two rear panel screws to fasten the main board in the case.

Connecting the Interfaces

Figure 2-3 shows a typical rear panel of a standard FOM-E3/ETH unit and identifies connector locations for the AC version.
The FOM-E3/ETH and FOM-T3/ETH rear panels contain also LAN status indicators, which duplicate the front panel LAN LEDs. The LINK and ACT indicators are located on the Ethernet interface connector.

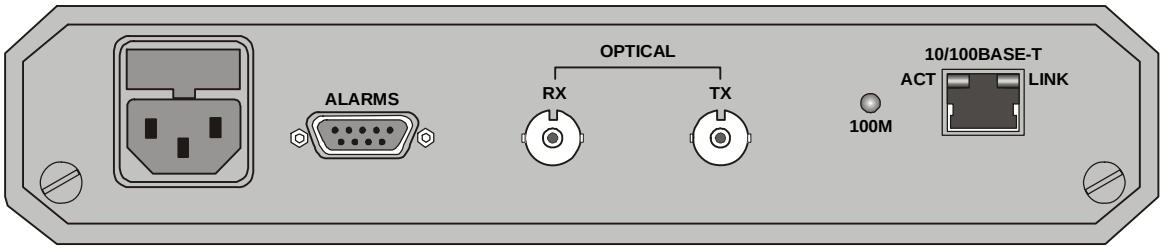
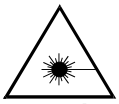


Figure 2-3. FOM-E3/ETH Rear Panel

Connecting the Fiber Optic Interface



Warning

This module includes Class 1 lasers. For your safety:

- **Do not look directly into the optical connectors while the module is operating. Remember that the module starts operating as soon as it is inserted in an operating DXC system.**
- **Do not attempt to adjust the laser drive current.**

The use of optical instruments with this product will increase eye hazard. Laser power up to 1 mW at 1300 nm and 1550 nm could be collected by an optical instrument.

Use of controls or adjustment or performing procedures other than those specified herein may result in hazardous radiation exposure.

The fiber optic interface of the FOM-E3/ETH or FOM-T3/ETH units terminate in ST, FC or SC connectors, designated TX and RX.

➤ **To connect the fiber optic interface:**

1. Remove the protective caps from the connectors and store them in a safe place for later use.
2. Connect the transmit fiber to the connector marked TX and the receive fiber to the connector marked RX.
3. At the remote unit connect the transmit fiber to the connector marked RX and the receive fiber to the connector marked TX.

Connecting the Ethernet Interface

The Ethernet interface of FOM-E3/ETH and FOM-T3/ETH terminates in an RJ-45 connector, designated 10/100BASE-T. *Table 2-3* lists the RJ-45 connector pinout.

➤ **To connect the Ethernet interface:**

- Connect the LAN to the FOM-E3/ETH or FOM-T3/ETH port, labeled 10/100BASE-T.

Table 2-3. RJ-45 Connector Pinout

Pin	Name	Function
1	RD (+)	Receive Data Positive
2	RD (-)	Receive Data Negative
3	TD (+)	Transmit Data Positive
6	TD (-)	Transmit Data Negative

Connecting the Power

To connect FOM-E3/ETH or FOM-T3/ETH to the power source, refer to the appropriate section below, depending on your version of the unit (AC or DC).

Warning

Before switching on this unit and connecting or disconnecting any other cable, the protective earth terminals of this unit must be connected to the protective ground conductor of the mains power cord. If you are using an extension cord (power cable) make sure it is grounded as well.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting of the protective earth terminal can make this unit dangerous. Intentional interruption is prohibited.

For the AC version, make sure that only fuses of the required rating, as marked on the rear panel, are used for replacement. Do not use repaired fuses or short-circuit the fuse holder. Always disconnect the mains cable before removing or replacing the fuse. Whenever it is likely that the fuse protection has been damaged, make the unit inoperative and secure it against unintended operation.

Connecting the AC Power

AC power should be supplied to FOM-E3/ETH and FOM-T3/ETH through the 1.5m (5 ft) standard power cable terminated by a standard 3-prong plug (see *Figure 2-3*). The cable is provided with the unit.

➤ To connect AC power:

- Connect the power cable first to the connector on the FOM-E3/ETH or FOM-T3/ETH rear panel, and then to the mains outlet.

  FOM-E3/ETH and FOM-T3/ETH will be turned on automatically upon connection to the mains.

Connecting the DC Power

➤ To connect DC power:

- Refer to the DC power supply connection supplement for instructions how to wire the DC cables. The DC supplement is provided on the technical documentation CD supplied with the unit.

Chapter 3

Operation

This chapter describes the FOM-E3/ETH and FOM-T3/ETH controls and indicators, and their functions, explains the units' operating procedures.

3.1 Front Panel Indicators and Controls

Figure 3-1 shows the front panel of FOM-E3/ETH. *Table 3-1* lists the functions of the FOM-E3/ETH LED indicators, located on the front panel.

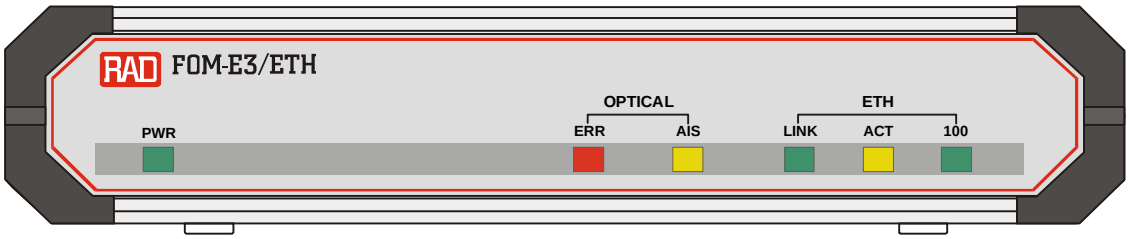


Figure 3-1. FOM-E3/ETH Front Panel

Table 3-1. FOM-E3/ETH and FOM-T3/ETH Controls and Indicators

Name	Type	Function
PWR	Green LED	ON – FOM-E3/ETH and FOM-T3/ETH is powered up
OPTICAL ERR	Red LED	ON – Bit error rate of the signal received from the optical interface is 10^{-6} or worse
OPTICAL AIS	Yellow LED	ON – Fiber optic interface received "All 1s" string
ETH LINK	Green LED	ON – LAN is connected to the Ethernet interface
ETH ACT	Yellow LED	ON – LAN is receiving/transmitting data
ETH 100	Green LED	ON – LAN is operating at 100 Mbps OFF – LAN is operating at 10 Mbps

3.2 Operating Instructions

Turning On

FOM-E3/ETH and FOM-T3/ETH start operating as soon as they are connected to the power source. The PWR LED turns ON and remains lit as long as the units are connected to the mains.

Normal Operating Instructions

The following LEDs conditions are observed during the normal operation:

- PWR is ON.
- LINK and ACT are ON to indicate data transfer over the Ethernet link.
- ETH 100 turns ON when FOM-E3/ETH and FOM-T3/ETH operate in Fast Ethernet (100 Mbps) mode.

The rest of the front panel LEDs are OFF.

Turning Off

Turn FOM-E3/ETH and FOM-T3/ETH off by disconnecting the power cord from the mains.

Chapter 4

Diagnostics and Troubleshooting

4.1 Alarm Relay

FOM-E3/ETH and FOM-T3/ETH include a dry contact alarm relay port supported via 9-pin connector for major and minor alarms.

- Major alarms are initiated bit error rate at the fiber optic interface is 10^{-6} or worse.
- Minor alarms occur when an Alarm Indication Signal is received at the fiber optic interface.

The dry contact port operates as Normally Open or Normally Closed, using different pins of the alarm relay port connector (see *Figure 4-1*).

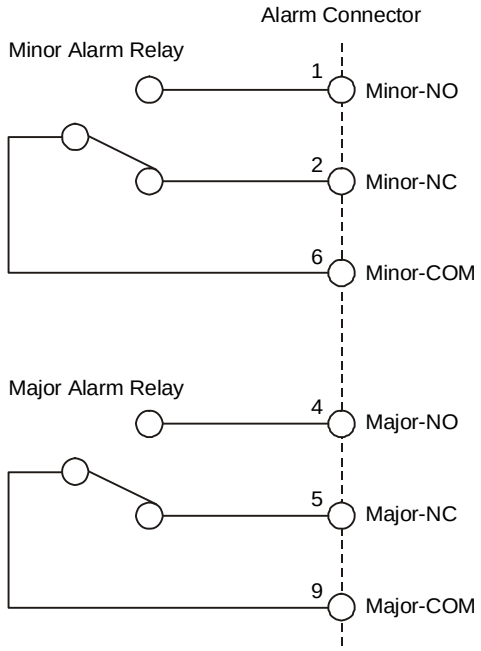


Figure 4-1. Alarm Relay Connector Pinout

Note *The relay positions are shown in the non-energized state (alarm active).*

4.2 Troubleshooting Instructions

In case a problem occurs, refer to *Table 4-1* for the troubleshooting procedures. Perform the actions listed under *Corrective Measures* in the order given in the table, until the problem is corrected.

Table 4-1. Troubleshooting Chart

Trouble Symptoms	Probable Cause	Corrective Measures
PWR indicator is OFF	No AC power	Verify that the power outlet is providing the required power. Ensure that the both ends of the power cable are connected properly.
	Blown fuse	Replace with a fuse of correct rating
Optical ERR indicator is ON	No optical connection	Ensure that both transmit and receive fiber cables are properly connected to the local and remote units.
	The optical budget is low	Measure the optical loss over the fiber link and check that it meets the product specifications.
OPTICAL AIS is ON	The equipment attached to the remote unit transmits "All 1s" string	Check the equipment attached to the remote FOM-E3/ETH or FOM-T3/ETH

4.3 Technical Support

Technical support for this product can be obtained from the local distributor from whom it was purchased.

For further information, please contact the RAD distributor nearest you or one of RAD's offices worldwide. This information can be found at www.rad.com (offices – About RAD > Worldwide Offices; distributors – Where to Buy > End Users).

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Customer Response Form

RAD Data Communications would like your help in improving its product documentation. Please complete and return this form by mail or by fax or send us an e-mail with your comments.

Thank you for your assistance!

Manual Name: FOM-E3/ETH, FOM-T3/ETH Ver. 1.0

Publication Number: 149-200-12/08

Please grade the manual according to the following factors:

	Excellent	*Good*	*Fair*	*Poor*	*Very Poor*
Installation instructions	❒	❒	❒	❒	❒
Operating instructions	❒	❒	❒	❒	❒
Manual organization	❒	❒	❒	❒	❒
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Type of error(s) or problem(s):

- ❒ Incompatibility with product
- ❒ Difficulty in understanding text
- ❒ Regulatory information (Safety, Compliance, Warnings, etc.)
- ❒ Difficulty in finding needed information
- ❒ Missing information
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